

**Technical Memorandum  
WRE # 368**

**Water Budget Analysis for the Everglades  
Nutrient Removal Project**

(August 20, 1997 to August 19, 1998)

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**By**

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## EXECUTIVE SUMMARY

The Everglades Nutrient Removal Project (ENR) is a 1,544 hectare (3,815 acre) constructed wetland designed and operated for the demonstration of phosphorus (P) reduction from agricultural runoff/drainage. The ENR is located in South Florida (26° 38' N, 80° 25' W) at the eastern edge of the Everglades Agricultural Area (EAA), a 240,000 ha (593,000 ac) area that is used primarily for growing sugarcane. Ecological changes in the Everglades have been partially attributed to an increase in phosphorus (P) concentrations in the inflow waters from the EAA.

The 1994 Everglades Forever Act requires that a minimum of 25% of the P load in agricultural drainage/runoff be removed at the basin level through the application of various agricultural Best Management Practices (BMPs) on the farms. Further removal of P is to be achieved through constructed wetland treatment systems known as Stormwater Treatment Areas (STAs) to an interim concentration of 50 parts per billion (ppb). The ENR Project is a field scale prototype for the large scale STAs and began full operation in August 1994. In order to operate the ENR effectively, quantify performance, and conduct mass balance studies, a water budget for the project is essential. Water budget analyses for the previous three years of the project (August 19, 1994 to August 19, 1996; August 20, 1996 to August 19, 1997) have been reported elsewhere (SFWMD, 1996 and Abtew and Mullen, 1997). This report summarizes the one-year water budget analysis covering the period from August 20, 1997 to August 19, 1998.

The total inflow through the inflow pump was 12,025 hectare-meters (ha-m) or 97,484 acre-feet (ac-ft) and the total outflow through the outflow pump was 11,450 ha-m (92,823 ac-ft). Seepage inflow from the L-7 levee through the roadside culverts was 757 ha-m (6,137 ac-ft). The seepage recirculation pumps had a total flow of 3,248 ha-m (26,331 ac-ft) and there was no significant flow through culverts G-258 and G-259 as the gates were closed except for three days. Compared to the average flows of the previous three years, this period had 29% lower inflow and 32% lower outflow pumping. Seepage recycle pumping was lower by 7.5%, while L-7 levee estimated seepage through road side culverts was higher by 39% compared to the average of the previous three years. Total areal average rainfall for the study period was 125.5 centimeters (cm) or 49.4 inches (in). Compared to the average areal rainfall for the previous three years, rainfall was lower by 29 cm (11.6 in). The total areal average evapotranspiration was 134.4 cm (52.9 in), which is 2.6% higher than the average ET reported for the previous three years the project was in operation. The remainders in the water balance, the sum of the errors and unknowns, was 9.1% of the inflows or the outflows of the system.

The mean hydraulic loading rate for the one-year period, based on the G-250 pump inflow, was 2.13 centimeters per day ( $\text{cm d}^{-1}$ ) or 0.84 inches per day ( $\text{in d}^{-1}$ ). The estimated mean hydraulic retention time was 25.4 days. The mean hydraulic retention time was computed as the ratio of the mean-estimated volume of the ENR and the total inflow pumping. The mean-estimated volume was computed from the area-weighted (by cell) mean depth of 54.1 cm (21.3 in) and total area of 1544 ha (3,815 ac). The ENR is a new system with a relatively short period of hydrologic record. Longer periods of record are more favorable to characterize the operation and water balance of hydrologic systems. Groundwater modeling will help to quantify subsurface sources and sinks in the system.



## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	i
TABLE OF CONTENTS .....	ii
LIST OF FIGURES .....	iii
LIST OF TABLES .....	iii
ACKNOWLEDGEMENTS .....	iv
INTRODUCTION .....	1
Background .....	1
Site Description .....	1
Vegetation Cover and Monitoring .....	3
SYSTEM HYDRAULICS AND OPERATION .....	3
System Hydraulics .....	3
Operation .....	4
HYDROLOGY AND HYDROLOGIC MONITORING .....	4
Rainfall .....	4
Evapotranspiration .....	7
Flows .....	8
Water Levels .....	8
WATER BUDGET COMPUTATIONS .....	11
Water Balance Model .....	11
Discussion .....	14
SUMMARY .....	16
REFERENCES .....	17
APPENDIX 1 .....	18

## LIST OF FIGURES

Figure 1. Location of the Everglades Nutrient Removal Project.....	2
Figure 2. ENR Project structures and monitoring network. ....	5
Figure 3. Daily distribution of areal average rainfall and evapotranspiration in the ENR Project.....	7
Figure 4. Daily pumping rates of inflow and outflow pumps in the ENR Project.....	9
Figure 5. Daily pumping rates of seepage pumps and seepage flow through L-7 levee roadside seepage collection culverts of the ENR Project.....	10
Figure 6. Daily mean water levels in the eastern cells of the ENR Project and the Buffer Cell.....	10
Figure 7. Daily mean water levels in the western cells of the ENR Project and the Buffer Cell.....	11
Figure 8. Schematic hydrologic model for the ENR Project.....	12
Figure 9. Distribution of daily remainders (errors and unknowns) from the ENR Project water balance. ....	14

## LIST OF TABLES

Table 1. Site characteristics of the Everglades Nutrient Removal Project.....	3
Table 2. Recommended water surface elevations and depths in the preliminary operation plan and observed stages. ....	6
Table 3. Rainfall stations in the ENR Project, database retrieval keys, and Thiessen weights.....	6
Table 4. ENR Project monthly flows, area weighted rainfall, and ET.....	7
Table 5. Flow control structures, stage recorders, and database retrieval keys used in the water budget analysis of the ENR Project.....	9
Table 6. Summary of the one-year water budget for the ENR Project. ....	15
Table 7. Comparison of ENR Project current year water budget components (ha-m) with the previous three years. ....	15

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## **INTRODUCTION**

### **Background**

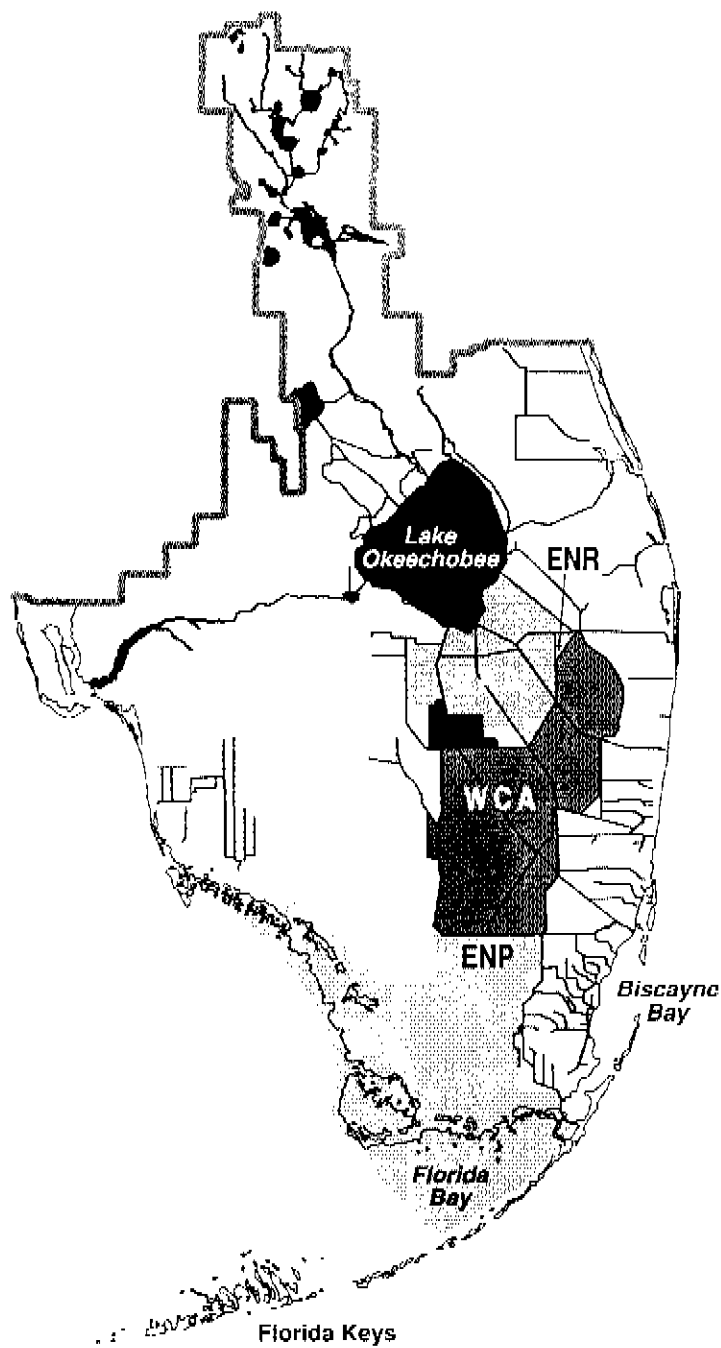
The Everglades Nutrient Removal (ENR) Project is a 1,544 hectare (ha) or 3,815 acre (ac) constructed wetland designed and operated for the demonstration of phosphorus reduction from agricultural runoff/drainage. The project is located in South Florida (26° 38' N, 80° 25' W) at the eastern edge of the Everglades Agricultural Area, a 240,000 ha (593,000 ac) area that is used primarily for growing sugarcane (Figure 1). Ecological changes in the Everglades have been partially attributed to an increase in phosphorus concentrations in the inflow waters of the EAA. Local, state and federal initiatives have been undertaken to reduce P load from agricultural runoff/drainage. Agricultural runoff/drainage from the EAA typically flows south and southeast through four primary canals (Miami, North New River, Hillsboro, and West Palm Beach).

The Everglades Forever Act requires that a minimum of 25% of the P load in agricultural drainage/runoff be removed at the basin level through the application of various agricultural Best Management Practices (Whalen and Whalen, 1994) on the farms. Further removal of P is to be achieved through constructed wetland treatment systems known as Stormwater Treatment Areas (STAs) to an interim outflow concentration of 50 ppb. The ENR Project is a field scale prototype for the large scale STAs. It is built on farm land that is owned by the State of Florida and previously leased (until 1988) to Knight's Farm for sugarcane and corn production. Originally, the land was part of the Everglades which consisted of wetland prairies, sloughs and stands of custard apple (Davis, 1943). Construction of the ENR started in August 1992 and was completed in October 1993. Full operation started in August 1994 and has continued over the past four years.

The purpose of this report is to analyze and document the hydrologic mass balance for the ENR Project. A water budgets is essential to quantify the performance of the wetland system in terms of hydraulic capacity, inflow, and outflow sources. This information is the basis for water quality load computations and performance efficiency evaluation.

### **Site Description**

The ENR Project area is primarily covered by Okeechobee muck soils with very low topographic relief and an average ground elevation of 3 meters (m) or 9.84 feet (ft) NGVD; a 1 to 2 m of peat overlies several meters of carbonate rock (Jammal and Associates, Inc., 1991). A 12 km (7.5 mile) levee surrounds the ENR and internal levees separate five interior cells. The ENR Project consists of two parallel treatment trains of two cells each and a buffer cell (distribution cell). To the east, the L-7 levee separates the ENR Project from the Loxahatchee Wildlife Refuge (Water Conservation Area 1 (WCA1)), Figure 2. The northern and western sides of the ENR are encompassed by a seepage return canal that separates the ENR levee from adjacent agricultural fields. The short southern ENR levee runs along Knight's Farm which currently is not under cultivation. As shown in Figure 2, the upper two cells, Cell 1 and 2, are referred to as flow way cells; the lower two cells, Cell 3 and 4, are polishing cells. The eastern treatment train carries water from the Buffer Cell to Cell 1, then to Cell 3 and finally to the outflow pump. The western treatment train carries water from the Buffer Cell to Cell 2, then to Cell 4 and finally to the outflow pump. Average ground elevation and area for each cell is shown in Table 1.



**Figure 1.** Location of the Everglades Nutrient Removal Project.

**Table 1.** Site characteristics of the Everglades Nutrient Removal Project.

Cell	Area ha (ac)	Average Ground Elev. m (ft) NGVD	Cattails (%)	Land Cover <sup>1</sup> Mixed veg. (%)	Open water (%)
Buffer	55 ( 136)	3.10 (10.17)	44.4	52.3	3.3
Cell 1	525 (1297)	3.08 (10.1 <sup>*</sup> )	35.0	20.0	45.0
Cell 2	414 (1023)	2.87 ( 9.4 <sup>*</sup> )	60.3	9.3	30.4
Cell 3	404 ( 998)	3.14 (10.3 <sup>*</sup> )	27.2	44.3	28.5
Cell 4	146 ( 361)	2.93 ( 9.6 <sup>*</sup> )	3.5	1.9	94.6
<b>Total</b>	<b>1544 (3815)</b>	<b>3.02 ( 9.92)</b>	<b>37.0</b>	<b>23.0</b>	<b>40.0</b>

<sup>1</sup>average land cover (based on October 21, 1997 and April 22, 1998 observations).

<sup>\*</sup>New ground elevation data provided by Mike Chimney.

### **Vegetation Cover and Monitoring**

As part of the ENR monitoring plan, temporal and spatial changes of vegetation have been documented using quarterly aerial photography prior to 1995 and semiannually since 1995. Average vegetation cover for the Buffer Cell and Cells 1, 2, 3, and 4 estimated from an aerial photograph of October 21, 1997 and April 22, 1998, is shown in Table 1. The dominant cover is open water/submerged vegetation (40%), followed by cattails (37%) and mixed vegetation (23%). Significant changes occurred in coverage over the last four years the project has been in operation. The first two years (August, 1994 to August, 1996), cattail was dominant (41.29%) followed by open water (35.7%). Last year (August, 1996 to August, 1997) cattail was dominant (47.7%) followed by mixed vegetation (30.2%). In this study vegetation cover information is used for evapotranspiration estimation.

## **SYSTEM HYDRAULICS AND OPERATION**

### **System Hydraulics**

West Palm Beach canal water that would otherwise be pumped into the Loxahatchee Wildlife Refuge or WCA1 via the S5-A Pump Station is partially diverted to the ENR through five culverts and a 3.4 km (2.1 mile) supply canal. Inflow into the constructed wetland, outflow from the constructed wetland, and seepage recycling are performed with lift pumps. The inflow pump station (G-250) has six identical pumps with a total capacity of 16.98 cubic meters per second ( $\text{m}^3\text{s}^{-1}$ ) or 600 cubic feet per second (cfs). The inflow pumps lift water from the delivery canal into the Buffer Cell. The outflow pump station (G-251) has six identical pumps with a total capacity of  $12.74 \text{ m}^3 \text{ s}^{-1}$  (450 cfs). The outflow pumps lift treated effluent from the ENR into the Loxahatchee Wildlife Refuge. Seepage from the seepage canal is pumped into the Buffer Cell by three identical pumps (G-250\_S) with a total capacity of  $5.66 \text{ m}^3 \text{ s}^{-1}$  (200 cfs). Pump discharge is computed as a function of head and tail water stages and pump rotations per minute (rpm). Water surface elevation is monitored by automated stage recorders. Staff gages supplement stage readings for operation.

Inter-cell flows are regulated with risers through 16.7 m (55 ft) long by 1.83 m (6 ft) diameter culverts. In the eastern treatment train, water flows from the Buffer Cell into Cell 1 through ten culverts (G252A-J) and from Cell 1 to Cell 3 through ten culverts (G253A-J). Water from Cell 3 is directed to the outflow pump through collection canals. In the western treatment train, water flows from the Buffer Cell into Cell 2 through five culverts (G255A-E) and from Cell 2 to Cell 4 through five culverts (G254A-I). Outflow from Cell 4 moves through five culverts (G256A-E) into a discharge canal that leads to the outflow pump. Water can be recirculated from Cell 2 and Cell 4 via the seepage canal by being released through culverts (G-258 and G-259, respectively) in the western levee. Water can be transferred from Cell 1 to Cell 4 through culvert G-257 when necessary. Flow through culverts is being monitored with Ultrasonic Velocity Meters (UVMs). ENR structure locations and monitoring network are shown in Figure 2.

## **Operation**

A preliminary operation plan was developed for the ENR by Guardo and Kosier (1993). The early start-up and late start-up water depths and stages recommended in this plan are presented for each cell in Table 2. The seepage pump started operation in December 1993. Pumping was mainly to recirculate water from the seepage canal and reroute water from cell to cell. The inflow and outflow pumps started operating on August 19, 1994, marking the beginning of full scale operation of the ENR. Inflow and outflow regulations in the ENR are based on the stage in each Cell, S-5A pump station status, seepage tests, construction operations, pump maintenance and other conditions. Information on ENR operations is available in the periodic summary of ENR site observations by site managers (Memoranda by Tom Kosier and Richard Meeker, SFWMD).

## **HYDROLOGY AND HYDROLOGIC MONITORING**

### **Rainfall**

South Florida has a subtropical climate with a relatively high rainfall frequency of occurrence and magnitude. On the average, 34% of the annual rainfall occurs in the dry season (November to May), with the remaining 66% occurring in the wet season (June to October). Mean annual rainfall for the area is 133 centimeters (cm) or 52 inches (in) as reported in Abtew and Khanal (1994). Frontal rainfall occurs in the dry season and have relatively lower spatial variation. Rainfall during the wet season is associated with daily convective and tropical systems which have high spatial variations.

Based on the high variation of summer rainfall observations in the area, a ten-gage rainfall network was established to evaluate the optimum gage density needed for the project area. Network analysis of the first wet season daily rainfall showed that five gages were sufficient for the area (Abtew *et al.*, 1995). As a result, three gages were removed. A seven-gage network is maintained because two of the gages are associated with the two weather stations, and four gages (one at the middle of each cell) are part of the monitoring network required by the operating permit. Table 3 lists all the rainfall gaging stations and their corresponding database keys, while Figure 2 shows gage locations. Areal average rainfall on the project site was computed using a Thiessen-weighted average of the seven-gage network (Table 3). Stations with few instances of data gaps were estimated from the closest gage. The daily distribution of areal average rainfall for the study area (August 20, 1997 to

August 19, 1998) is depicted by Figure 3. Monthly summary of areal average rainfall is shown in Table 4. The total areal average rainfall for the study period was 125.5 cm (49.4 in). Compared to the yearly average areal rainfall for the previous three years, rainfall was lower by 29 cm (11.6 in).

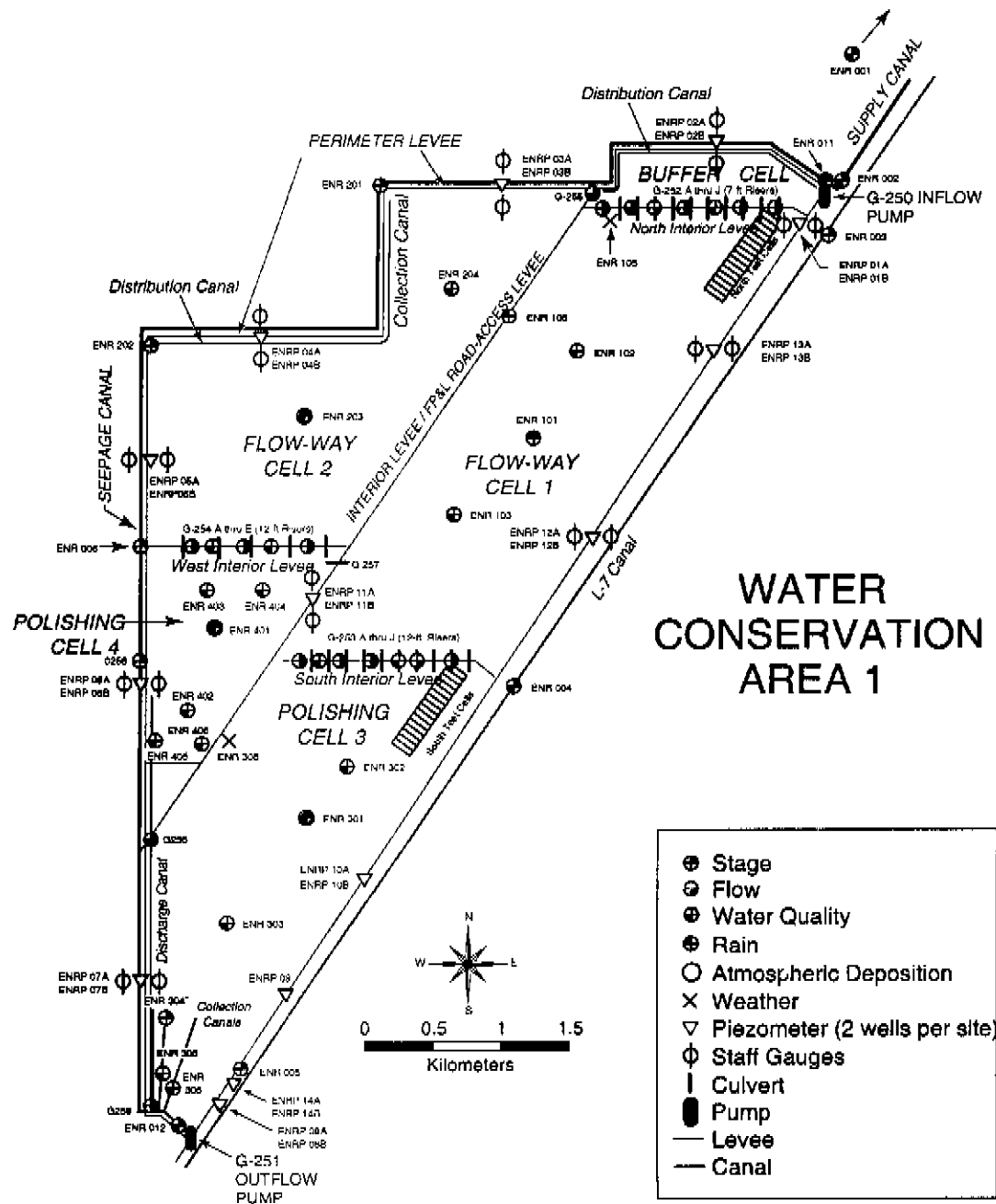


Figure 2. ENR Project structures and monitoring network.

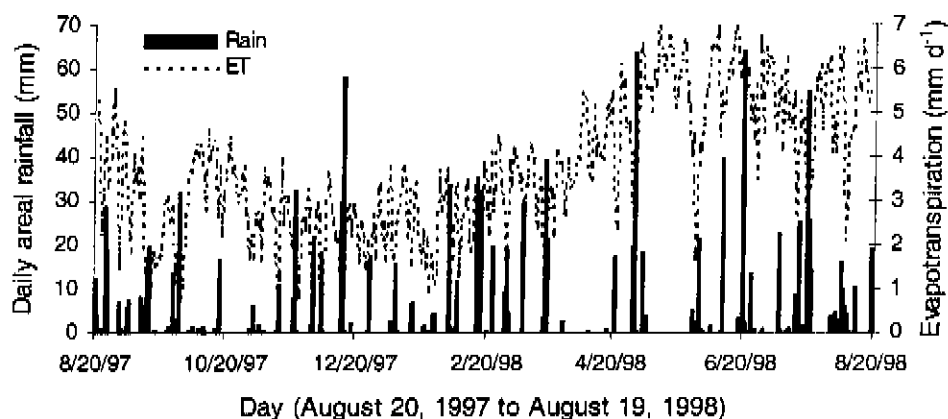
**Table 2.** Recommended water surface elevations and depths in the preliminary operation plan and observed stages.

Cell	Early Start-up Plan		Later Start-up Plan		Observed Stages			
	Target Stage	Target Depth	Target Stage	Target Depth	Minimum	Maximum	Mean	Mean Depth
	m (ft) NGVD	cm (in)	m (ft) NGVD	cm (in)	m (ft) NGVD	m (ft) NGVD	m (ft) NGVD	cm (in)
Buffer	3.78 (12.40)	67 (26.4)	3.78 (12.4)	67 (26.4)	3.46 (11.35)	3.92 (12.86)	3.73 (12.23)	63 (24.8)
Cell 1	3.63 (11.91)	49 (19.3)	3.66 (12.00)	52 (20.5)	3.44 (11.28)	3.84 (12.60)	3.58 (11.7)	50 (19.7)
Cell 2	3.54 (11.61)	58 (22.8)	3.63 (11.91)	67 (26.4)	3.41 (11.18)	3.86 (12.66)	3.67 (12.04)	51 (31.3)
Cell 3	3.51 (11.51)	40 (15.8)	3.57 (11.71)	46 (18.1)	3.25 (10.76)	3.76 (12.33)	3.59 (11.72)	25 (9.8)
Cell 4	3.29 (10.79)	30 (11.8)	3.57 (11.71)	58 (22.8)	3.36 (11.02)	3.84 (12.60)	3.63 (11.91)	30 (27.7)

-National Geodetic Vertical Datum.

**Table 3.** Rainfall stations in the ENR Project, database retrieval keys, and Thiessen weights.

Stations	DBKEY	Thiessen Weights
ENR101	15851	0.160
ENR105	15861	0.143
ENR106	DU515	0.107
ENR203	15874	0.183
ENR301	15877	0.224
ENR308	15888	0.072
ENR401	15862	0.111



**Figure 3.** Daily distribution of areal average rainfall and evapotranspiration in the ENR Project.

**Table 4.** ENR Project monthly flows, area weighted rainfall, and ET.

Year	Month	Inflow G-250 (Pump) ha-m <sup>1</sup>	Outflow G-251 (Pump) ha-m	Rainfall cm (in)	ET cm (in)	Seepage G-250_S (Pump) ha-m	Recirculation G-258+G-259 (Culverts) ha-m	Seepage L-7 (Culverts) ha-m
1997	Aug <sup>‡</sup>	373.37	298.71	7.15 (2.81)	4.60 (1.81)	132.79	0.58	24.46
1997	Sept	568.48	781.89	11.48 (4.52)	7.19 (2.83)	291.51	0.00	71.30
1997	Oct	829.33	704.68	2.44 (0.96)	10.73 (4.23)	290.67	0.00	104.35
1997	Nov	753.34	742.56	8.39 (3.30)	7.06 (2.78)	240.52	0.00	109.02
1997	Dec	1198.72	1209.84	12.73 (5.01)	7.04 (2.77)	220.21	0.00	149.53
1998	Jan	618.12	744.16	4.62 (1.82)	7.56 (2.98)	199.06	0.00	95.10
1998	Feb	806.73	750.77	14.92 (5.87)	7.51 (2.96)	155.41	0.00	97.78
1998	Mar	653.18	769.04	12.00 (4.72)	10.04 (3.95)	211.51	0.00	62.55
1998	Apr	1727.96	1028.02	10.20 (4.01)	13.07 (5.15)	202.56	0.00	7.64
1998	May	2501.59	2146.92	5.21 (2.05)	17.00 (6.69)	299.71	0.00	10.49
1998	June	483.38	714.47	12.74 (5.02)	17.12 (6.74)	344.94	0.00	1.25
1998	July	1007.24	1089.27	16.15 (6.36)	15.51 (6.11)	418.44	0.00	8.56
1998	Aug <sup>†</sup>	503.31	469.25	7.52 (2.96)	9.97 (3.93)	240.31	0.00	15.23

<sup>1</sup>ha-m = 8.1068 ac-ft, <sup>‡</sup>12 days, <sup>†</sup>19 days.

## Evapotranspiration

Daily evapotranspiration is computed from high resolution weather data using two models. Complete weather stations are located in Cell 1 (ENR105) and Cell 3 (ENR308). Based on initial observations, the Penman-Monteith model for cattails and mixed-marsh vegetation, and the Penman-Combination equation for shallow open water conditions were calibrated for this site (Abtew and Obeysekera, 1995; Abtew, 1996). For the water budget analysis of the ENR, areal average daily ET was computed based on percent type of land cover (Table 1) and area of each cell. Distribution of daily areal ET from the ENR, for the study period (August 20, 1997 to August 19, 1998), is shown in Figure 3, while the monthly summary of areal ET is presented in

Table 4. The areal average ET for the year was 134.4 cm (52.9 in) which is 2.6% higher than the average ET for the previous three years the project was in operation.

## Flows

Database keys for the flow structures and daily stage gages are listed in Table 5. For the study period, the inflow pump (G-250) and the outflow pumps (G-251) were in operation 76% and 98% of the days, respectively. The seepage return pumps (G-250-S) operated every day during the study period. The daily pumping rates of the inflow and outflow pumps are shown in Figure 4. Culverts G-258 and G-259 were closed through-out the period except for three days. Figure 5 shows estimated seepage from the I-7 levee flowing through the roadside culverts and the daily seepage recycling pumping. The I-7 seepage through the roadside culverts was estimated using a regression equation developed from 42 data points. The equation was developed using relationships between the seepage from I-7 through the roadside culverts, the stage rise in WCA-1 above 4.57 m (15 ft) NGVD, and the difference in stages between WCA-1 and the eastern cells of the ENR (Guardo, 1996). The regression fit coefficient of determination ( $R^2$ ) was 0.93 with a standard error of 0.30  $\text{m}^3 \text{s}^{-1}$ . The equation is given as follows:

$$\text{I-7 seepage} = 0.2158 \text{AWCA}^{1.3121} \Delta h^{2.0246} \quad (1),$$

where I-7 seepage is in  $\text{m}^3 \text{s}^{-1}$ ; AWCA is the change in stage in WCA-1 above 4.57 m (15 ft) NGVD; and  $\Delta h$  is the difference in stage between WCA-1 and the eastern cells of the ENR. For the study period the average stage of WCA-1 was 5.00 m (16.40 ft) and the eastern cells of the ENR average stage was 3.49 m (11.43 ft). Monthly flow data for the study period are presented in Table 4. Compared to the previous three years average flow, the current period had 29% lower inflow and 32% lower outflow pumping. Seepage recycle pumping was lower by 7.5% while I-7 levee estimate of seepage through road side culverts was higher by 39% compared to average of the previous three years.

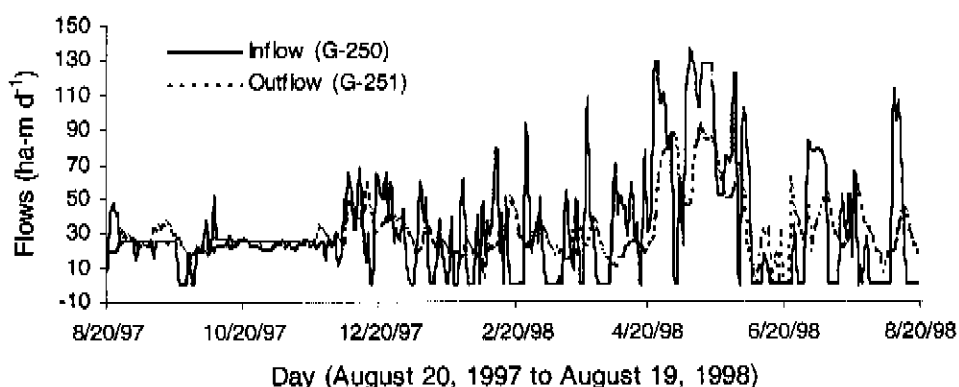
## Water Levels

Daily water levels in each cell of the ENR are dependent on rainfall, evapotranspiration, seepage, and daily operational decisions. Water levels have been regulated based on water depth, operation status of the S-5A pump station, pump maintenance, and other activities in ENR such as seepage studies and construction operations. The minimum, maximum, and mean of the daily average stage observations for the study period are shown in Table 2. The mean observed stage in the Buffer Cell was approximately the same as the mean of the previous three years. The mean stages over the period from August 20, 1997 through August 19, 1998 are compared to the previous three years average stages as follows: Cell 1 decreased by 8.9 cm (3.5 in); Cell 2 increased by 2.6 cm (1 in); Cell 3 decreased by 13.9 cm (5.5 in); Cell 4 increased by 7.8 cm (3.1 in). Average daily water level observations in the eastern treatment train of the ENR are shown in Figure 6, while those in the western treatment train are shown in Figure 7. The average depth of water was 54.1 cm (21.3 in) compared to a 55.7 cm (21.9 in) mean depth over the past three years.

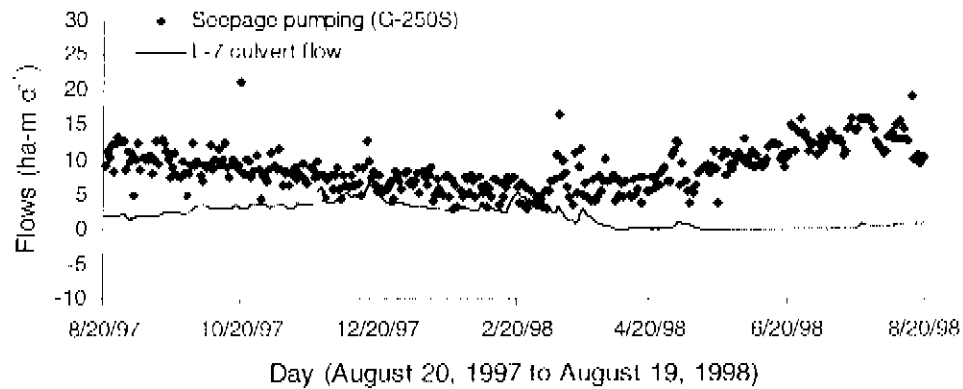


**Table 5.** Flow control structures, stage recorders, and database retrieval keys used in the water budget analysis of the ENR Project.

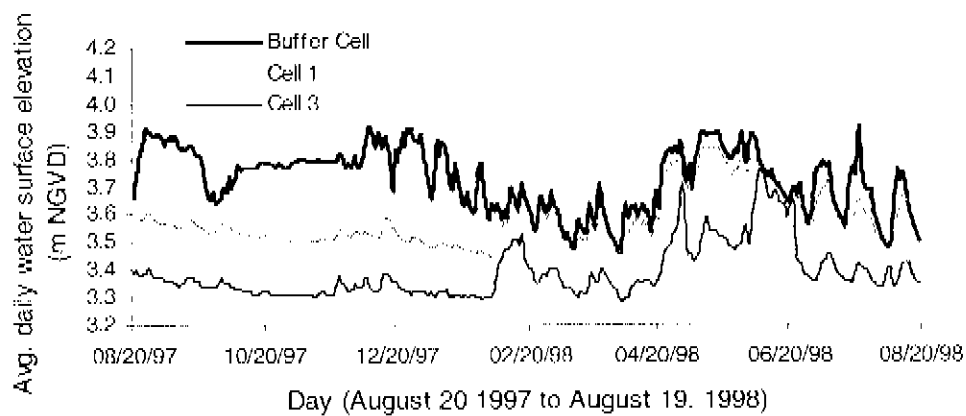
Station	Description	Location	DBKEY	Remark
G250_P	Pump	Feeder Canal/Buffer Cell	15847	inflow
G250S_P	Pump	Seepage Canal/Buffer Cell	15846	seepage return
G251_P	Pump	Cell 4/WCA 1	15848	outflow
G258_C	Culvert	Cell 3/Seepage Canal	15940	recycle
G259_C	Culvert	Cell 4/Seepage Canal	15939	recycle
G252EF_H	Stage	Buffer Cell/Cell 1	15891	head water
G255_H	Stage	Buffer Cell/Cell 2	15908	head water
G252EF_T	Stage	Buffer Cell/Cell 1	15892	tail water
ENR101	Stage	Cell 1	15850	center of cell
G253EF_H	Stage	Cell 1/Cell 3	15897	head water
G255_T	Stage	Buffer Cell/Cell 2	15909	head water
ENR203	Stage	Cell 2	15873	center
G254C_H	Stage	Cell 2/Cell 4	15903	head water
G253EF_T	Stage	Cell 1/Cell 3	15898	tail water
ENR301	Stage	Cell 3	15876	center
ENR012	Stage	Cell 3	15849	upstream of G251_P
G254C_T	Stage	Cell 2/Cell 4	15904	tail water
ENR401	Stage	Cell 4	15727	center of cell
G256_H	Stage	Cell 4B/Discharge Canal	15910	head water
ENR003	Stage	East end of Buffer Cell	15812	WCA1
ENR004	Stage	L7 canal at junction of ENR	15842	WCA1
ENR005	Stage	L7 canal near G-251	15843	WCA1



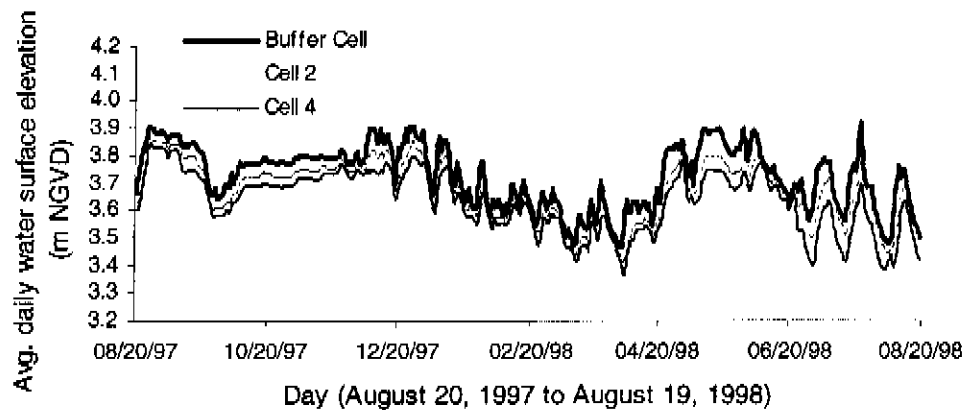
**Figure 4.** Daily pumping rates of inflow and outflow pumps in the ENR Project.



**Figure 5.** Daily pumping rates of seepage pumps and seepage flow through L-7 levee roadside seepage collection culverts of the ENR Project.



**Figure 6.** Daily mean water levels in the eastern cells of the ENR Project and the Buffer Cell.



**Figure 7.** Daily mean water levels in the western cells of the ENR Project and the Buffer Cell.

## WATER BUDGET COMPUTATIONS

### Water Balance Model

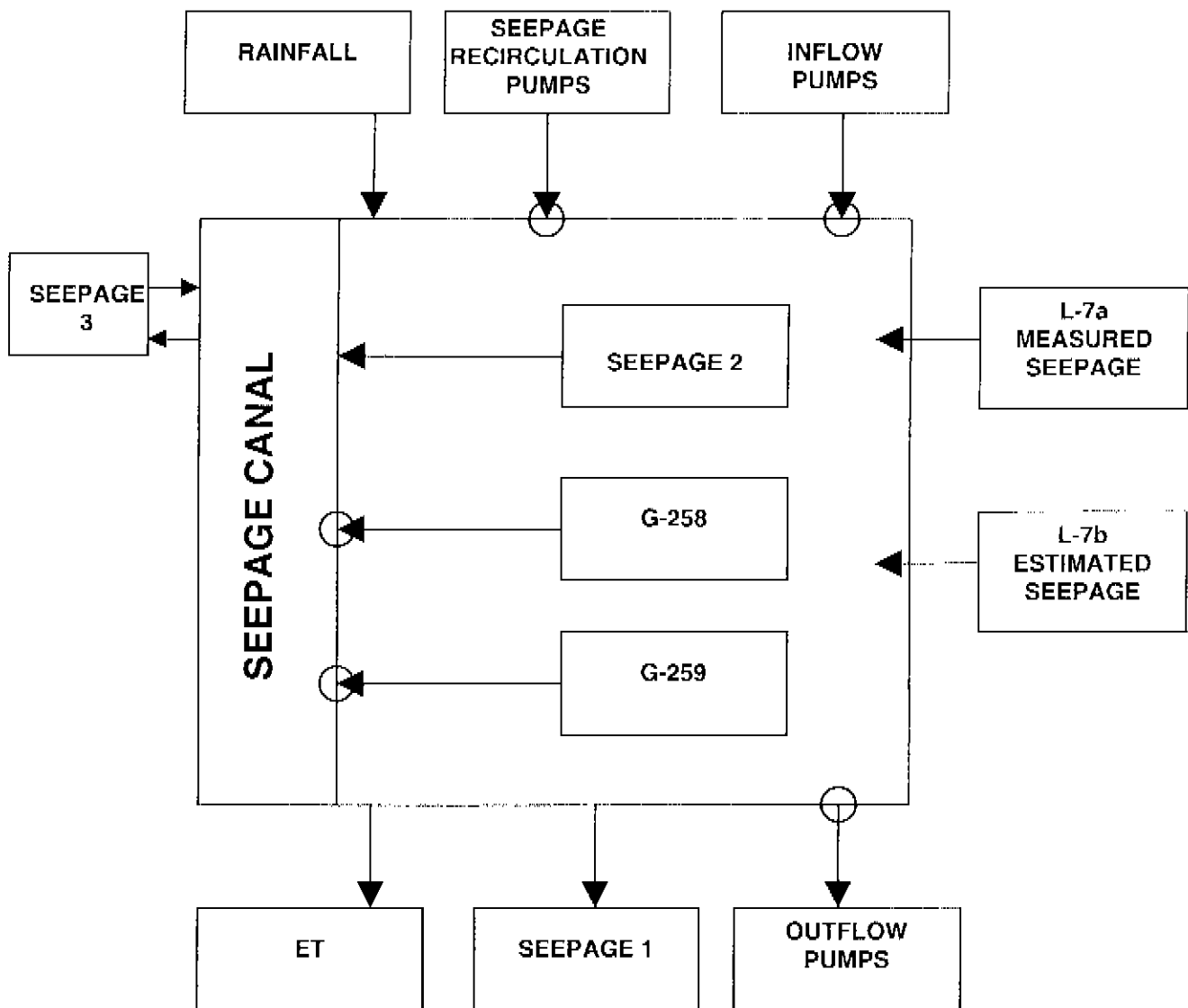
The schematic hydrologic model for the ENR is depicted in Figure 8. The influent pumped through the G-250 pump station accounted for approximately 81.7% of the known inflow to the system. The known inflows to the system are the G-250 pump station inflows, rainfall, and seepage through the roadside L-7 levee culverts (L-7a). Rainfall accounts for 13.2% and seepage through the roadside L-7 culverts (L-7a) accounts for 5.1% of the known inflows. Outflow pumping (G-251) accounts for 77.0% of the outflows, with evapotranspiration constituting 13.9% of the total outflows. The unknowns in the system are subsurface inflows, subsurface outflows, and errors. The schematic model (Figure 8) and the following set of water balance equations represent the hydrologic system of the ENR for water budget analysis purposes:

$$\text{INFLOW} - \text{OUTFLOW} = \Delta S + \epsilon_T \quad (2),$$

where INFLOW is the amount of water that enters the system from external sources, and OUTFLOW is water that leaves the system boundary and is not recirculated.  $\Delta S$  is the change in system storage during the time interval of interest. The sum of all errors is represented by  $\epsilon_T$ . Because all inflows and outflows can not be entirely quantified, the following equation is introduced to represent the remainders:

$$\text{REMAINDERS} = \epsilon_T + \text{UNKNOWNNS} \quad (3).$$

Figure 8 shows the possible inflows and outflows to and from the ENR system. The seepage canal which encompasses the northern and western sides of the ENR was designed and is operated to capture seepage from the ENR to neighboring farms.



**Figure 8.** Schematic hydrologic model for the ENR Project.

When opened, and/or through leakage, G-258 and G-259 culverts release water into the seepage canal. Seepage through the western and northern ENR levees is represented in the model by SEEPAGE 2, regardless of the magnitude. SEEPAGE 3 represents the two seepage possibilities into or out of the seepage canal from or to the surrounding farms, regardless of the magnitude. SEEPAGE 1 represents the possible seepage loss through the southern ENR levee into Knight's Farm. The unmeasured seepage flow from WCA 1 into the ENR Project (subsurface seepage from WCA-1 that is not captured by the roadside culverts) is represented by L-7b.

In computing the water balance for the ENR, the objectives were to identify quantifiable variables and make reasonable assumptions to reduce unknowns as much as possible. Since the purpose of the seepage canal is to recirculate seepage and recycled water, it is assumed that the seepage return pump flows (G-250\_S) are recirculated in the system as designed. This scenario is represented in the following equation:

$$S_P = \text{SEEPAGE } 2 + G_{258} + G_{259} + \epsilon_R \quad (4),$$

where  $S_P$  is seepage return pump flows (G-250\_S); SEEPAGE 2 is seepage from the ENR to the seepage canal; G-258 and G-259 are flows through the respective culverts from the ENR to the seepage canal; and  $\epsilon_R$  is error due to assumptions, measurements, calibration, and any other unaccounted factors. The error term also includes the net effect of the unknown variable SEEPAGE 3, which is the net subsurface flow of water from the seepage canal to the adjacent farms (west and north) or from the farms to the seepage canal. Also, SEEPAGE 1 and L-7b (subsurface seepage from WCA 1 that is not captured by the roadside culverts) are unknowns. Equation 2 is thereby expanded as follows:

$$\Delta S = G_{250} + R + L_{7a} + L_{7b} - G_{251} - ET - \text{SEEPAGE } 1 + \epsilon_R + \epsilon_I + \epsilon_O \quad (5),$$

where  $\Delta S$  is change in system storage; G-250 is inflow pump flows; R is rainfall; L-7a is estimated seepage flows from WCA 1 through the roadside culverts; L-7b is unknown seepage subsurface flow from WCA 1 into the ENR; ET is evapotranspiration; SEEPAGE 1 is seepage loss through the southern levee of the ENR;  $\epsilon_R$  represents errors in accounting for the recirculation water in the system;  $\epsilon_I$  represents errors in inflow terms; and  $\epsilon_O$  represents errors in outflow terms. The total error in the system is expressed as follows:

$$\epsilon_T = \epsilon_R + \epsilon_I + \epsilon_O \quad (6).$$

Daily change in storage for the ENR was computed as the sum of storage changes in each of the five cells (Buffer Cell, Cell 1, Cell 2, Cell 3 and Cell 4). Change in storage volume in each cell was computed from the area of the cell and change in stage. Change in stage was computed as the difference between mean daily stages of the previous and current day averaged from two or three locations in each cell (Table 5).

The remainders in the computation of daily water balance are the sum of all errors and unknowns in the system. Daily remainders were computed for the one-year study period based on the following equation:

$$\text{REMAINDERS} = \epsilon_1 - \text{SEEPAGE 1} + \text{L7b} \quad (7),$$

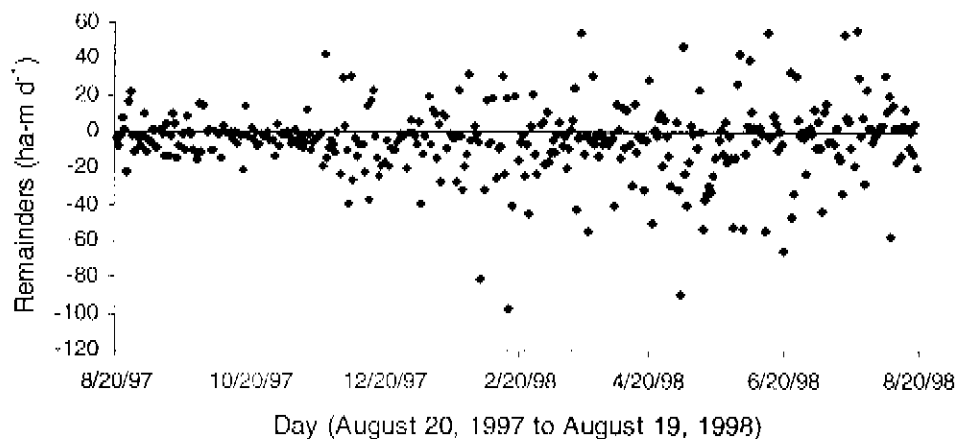
where  $\epsilon_1$  is the sum of all errors.

## Discussion

The total inflow through the inflow pumps was 12,025 ha-m (97,484 ac-ft) and total outflow through the outflow pumps was 11,450 ha-m (92,823 ac-ft). Total seepage inflow from the I-7 levee through the roadside culverts was 757 ha-m (6,137 ac-ft). There was no significant measured flow into the seepage canal through culverts G-258 and G-259. The seepage recirculation pump had a total flow of 3,248 ha-m (26,331 ac-ft). Total average areal rainfall for the study period was 125.5 cm (49.4 in) and the total average areal evapotranspiration was 134.4 cm (52.9 in).

For the study period, the mean daily remainders (errors and unknowns) was -3.70 ha-m (-30.0 ac-ft) with total remainders -1,348.9 ha-m (-10,935 ac-ft) computed from daily data. The standard deviation of the daily remainders is 21.83 ha-m d<sup>-1</sup> (176.7 ac-ft d<sup>-1</sup>) which signifies high variation but there was no systematic variation during the one year study period (Figure 9). The negative remainder indicates that there is an overall outflow from the system through unidentified directions. The remainder was 9.1 % of the inflows or the outflows. Summary of the one-year water budget is shown in Table 6. Details of the water balance terms and calculations are shown in Appendix I.

The mean hydraulic loading rate for the study period, based on the G-250 pump inflow, was 2.13 centimeters per day (cm d<sup>-1</sup>) or 0.84 inches per day (in d<sup>-1</sup>). The mean hydraulic retention time was computed as the ratio of the mean-estimated volume of the ENR and the total inflow pumping. The mean-estimated volume was computed from the area weighted (by cell) mean depth of 54.1 cm (21.3 in) and total area of 1,544 ha (3,815 ac). The estimated mean hydraulic retention time was 25.4 days. Comparison of the current year ENR water budget components with the previous three years is shown in Table 7.



**Figure 9.** Distribution of daily remainders (errors and unknowns) from the ENR Project water balance.

**Table 6.** Summary of the one-year water budget for the ENR Project.

INFLOWS	ha-m <sup>†</sup>	Percent of Total	OUTFLOWS	ha-m	Percent of Total
Inflow Pump	12,025	81.7%	Outflow Pump	11,450	77.0%
Rain	1,938	13.2%	ET	2,074	13.9%
L-7 Culverts (L7a)	757	5.1%	Remainders	1,349	9.1%
<b>Total</b>	<b>14,720</b>	<b>100%</b>	<b>Total</b>	<b>14,873</b>	<b>100%</b>

Change in Storage -153

ha-m = 8.1068 ac-ft<sup>†</sup>

**Table 7.** Comparison of ENR Project current year water budget components (ha-m) with the previous three years.

	8/19/94 to 8/19/96 (2 years)	8/20/96 to 8/19/97 (1 year)	8/20/97 to 8/19/98 (1 year)
<b>INFLOWS</b>			
Inflow pump	39,000	11,972	12,025
Rain	5,068	2,108	1,938
L-7 Culverts (L7a)	<u>1,198</u>	<u>431</u>	<u>757</u>
<b>Total</b>	<b>45,266</b>	<b>14,511</b>	<b>14,720</b>
<b>OUTFLOWS</b>			
Outflow pump	38,802	11,872	11,450
ET	4,050	2,008	2,074
Remainders	<u>2,781</u>	<u>547</u>	<u>1,349</u>
<b>Total</b>	<b>45,633</b>	<b>14,427</b>	<b>14,873</b>
Change in Storage	-363	83	-153
Seepage recirculation			
Seepage pump	7,143	3,385	3,248
Loading Rate (cm d <sup>-1</sup> )	3.45	2.12	2.13
Average depth (cm)	57.5	52	54.1
Retention time (days)	17	24.5	25.4

## SUMMARY

The ENR Project has been in full operation for the last four years. This study covers the ENR water budget during the one-year period from August 20, 1997 to August 19, 1998. For the current one-year period of analysis, the total inflow through the inflow pumps was 12,025 hectare-meters (ha-m) or 97,484 acre-feet (ac-ft) and the total outflow through the outflow pumps was 11,450 ha-m (92,823 ac ft). Total seepage inflow from the L-7 levee through the roadside culverts was 757 ha-m (6,137 ac-ft). The seepage recirculation pump had a total flow of 3,248 ha-m (26,331 ac-ft) and there was no significant measured flow through culverts G-258 and G-259 as the gates were closed, except for three days. Compared to the previous three year average flows, this period had 29% lower inflow and 32% lower outflow pumping. Seepage recycle pumping was lower by 7.5% while L-7 levee estimate of seepage through road side culverts increased 39% compared to the average of the previous three years. Total areal average rainfall for the study period was 125.5 centimeters (cm) or 49.4 inches (in) and the total areal average evapotranspiration was 134.4 cm (52.9 in) which is 2.6% higher than the average ET of the previous three years the project was in operation. Compared to the average areal rainfall for the previous three years, rainfall was lower by 29 cm (11.6 in). The remainders in the water balance, the sum of the errors and unknowns, was 9.1% of the inflows or the outflows of the system.

The mean hydraulic loading rate for this one-year period, based on the G-250 pump inflow, was 2.13 centimeters per day (cm d<sup>-1</sup>) or 0.84 inches per day (in d<sup>-1</sup>). The loading rate for this study period was the same as the previous year. The mean hydraulic retention time was computed as the ratio of the mean-estimated volume of the ENR and the total inflow pumping. The mean-estimated volume was computed from the area-weighted (by cell) mean depth of 54.1 cm (21.3 in) and total area of 1,544 ha (3,815 ac). The estimated mean hydraulic retention time was 25.4 days which is about the same as the previous year. The ENR is a new system with a relatively short period of hydrologic record. Longer periods of record are more favorable to characterize the operation and water balance of wetland systems.

In the ENR Project, all hydrologic parameters are monitored, with the exception of seepage. Seepage is not in one direction, therefore, the remainders (errors and unknowns) could not be allocated to one variable. Groundwater modeling efforts will help in identifying and quantifying subsurface sources and sinks in the system. Improvement in stage-volume relationships will also increase the accuracy of water balance analysis.



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## APPENDIX 1



Appendix 1. Everglades Nutrient Removal Project water balance terms with calculated remainders.  
ha-m = 8.1068 ac-ft.

Date	Change In Storage (ha-m)	Inflow Pump G-250 (ha-m)	Seepage Pump G-250_S (ha-m)	Outflow Pump G-251 (ha-m)	Culvert G-258 (ha-m)	Culvert G-259 (ha-m)	Seepage L-7a (ha-m)	Rain (ha-m)	ET (ha-m)	Remainders (ha-m)
8/20/1997	-1.109	9.038	9.302	19.373	0.000	0.000	2.151	18.976	8.291	-3.610
8/21/1997	12.030	38.306	11.375	20.315	0.000	0.000	2.092	6.269	6.722	-7.600
8/22/1997	20.560	43.813	10.487	19.877	0.000	0.000	2.088	0.278	3.541	-2.201
8/23/1997	32.860	47.143	12.263	19.877	0.000	0.000	2.056	1.065	4.953	7.426
8/24/1997	17.150	41.127	8.512	20.259	0.000	0.000	2.009	0.463	6.914	0.724
8/25/1997	35.900	41.296	12.324	24.585	0.000	0.000	1.997	44.158	5.067	-21.899
8/26/1997	34.900	23.650	13.401	31.147	0.000	0.193	2.130	28.950	5.302	16.619
8/27/1997	12.780	25.737	12.637	30.701	0.000	0.206	2.216	0.000	6.424	21.952
8/28/1997	-10.750	25.894	12.662	28.646	0.000	0.184	2.247	0.046	8.616	-1.675
8/29/1997	-18.570	25.644	8.644	28.536	0.000	0.000	2.096	0.000	6.553	-11.221
8/30/1997	-9.290	25.854	11.363	27.232	0.000	0.000	1.776	0.000	6.396	-3.292
8/31/1997	0.000	25.869	9.819	28.218	0.000	0.000	1.597	10.190	2.208	-7.230
9/1/1997	-4.700	25.852	10.900	25.612	0.000	0.000	1.616	1.529	5.683	-2.402
9/2/1997	-6.700	14.086	5.094	24.758	0.000	0.000	1.777	0.124	7.440	9.511
9/3/1997	-17.800	19.486	10.102	22.647	0.000	0.000	1.922	0.355	6.365	-10.551
9/4/1997	6.700	25.620	12.535	22.759	0.000	0.000	1.962	9.418	3.384	-4.157
9/5/1997	7.060	25.791	8.808	23.462	0.000	0.000	2.053	10.978	2.804	-5.496
9/6/1997	0.550	25.446	10.499	21.991	0.000	0.000	2.205	0.000	6.134	1.024
9/7/1997	-0.550	25.597	10.181	23.968	0.000	0.000	2.106	0.154	5.279	0.839
9/8/1997	-8.740	26.102	10.058	22.703	0.000	0.000	2.000	0.000	5.714	-8.425
9/9/1997	-8.720	26.199	10.800	33.473	0.000	0.000	1.999	0.000	4.639	1.194
9/10/1997	-23.950	15.590	8.209	34.053	0.000	0.000	1.973	0.000	6.859	-0.601
9/11/1997	-7.710	26.180	10.232	30.966	0.000	0.000	1.949	12.398	4.302	-12.969
9/12/1997	5.800	25.786	12.672	34.203	0.000	0.000	2.226	10.160	2.106	3.937
9/13/1997	3.490	25.737	9.540	32.536	0.000	0.000	2.229	23.484	2.431	-12.993
9/14/1997	20.690	25.903	13.129	34.937	0.000	0.000	2.424	30.309	1.177	-1.832
9/15/1997	0.550	25.965	12.549	35.661	0.000	0.000	2.575	0.046	1.702	9.327
9/16/1997	-6.150	23.302	11.343	34.435	0.000	0.000	2.680	0.278	2.824	4.849
9/17/1997	-20.130	25.935	10.188	32.365	0.000	0.000	2.600	0.633	2.475	-14.458
9/18/1997	-11.400	26.258	7.470	30.337	0.000	0.000	2.590	0.000	2.341	-7.570
9/19/1997	-5.600	26.253	8.864	30.300	0.000	0.000	2.589	0.077	2.824	-1.396
9/20/1997	-13.880	26.170	10.927	27.973	0.000	0.000	2.590	0.000	4.494	-10.173
9/21/1997	-11.390	9.647	7.749	28.039	0.000	0.000	2.526	0.000	4.494	8.970
9/22/1997	-26.810	0.000	7.526	24.443	0.000	0.000	2.464	0.000	4.730	-0.101
9/23/1997	-22.590	0.000	9.770	20.655	0.000	0.000	2.462	0.463	3.843	-1.017
9/24/1997	-27.840	0.000	8.013	17.991	0.000	0.000	2.446	1.806	3.843	-10.258
9/25/1997	-12.660	15.417	5.006	15.324	0.000	0.000	2.479	0.077	4.314	-10.995
9/26/1997	7.250	18.546	8.150	17.315	0.000	0.000	2.581	20.782	1.804	-15.540
9/27/1997	3.050	0.000	9.317	17.112	0.000	0.000	2.652	4.941	2.431	15.001
9/28/1997	19.130	0.000	12.576	19.880	0.000	0.000	2.889	49.146	1.659	-11.366
9/29/1997	10.390	15.409	9.386	21.511	0.000	0.000	3.280	0.077	1.165	14.300
9/30/1997	3.210	22.204	9.914	20.479	0.000	0.000	3.455	0.000	1.792	-0.178
10/1/1997	1.010	19.246	7.896	20.014	0.000	0.000	3.497	0.000	3.192	1.473
10/2/1997	-11.400	18.916	7.091	19.566	0.000	0.000	3.461	0.232	4.632	-9.811

Date	Change In Storage	Inflow Pump G 250 (ha-m)	Seepage Pump G 250_S (ha-m)	Outflow Pump G 251 (ha-m)	Culvert G 258 (ha-m)	Culvert G 259 (ha-m)	Seepage 1-7a (ha-m)	Rain (ha-m)	ET (ha-m)	Remainders (ha-m)
10/3/1997	8.900	38.301	9.244	18.042	0.000	0.000	3.497	0.355	5.659	-9.452
10/4/1997	0.290	21.602	8.965	19.968	0.000	0.000	3.483	0.000	5.581	0.174
10/5/1997	1.450	24.651	9.329	21.548	0.000	0.000	3.381	2.162	6.600	0.595
10/6/1997	2.110	26.339	12.082	20.021	0.000	0.000	3.337	0.046	6.051	-1.540
10/7/1997	12.490	51.303	8.730	21.411	0.000	0.000	3.307	0.000	6.600	-14.459
10/8/1997	4.850	26.312	10.024	23.383	0.000	0.000	3.324	1.683	6.298	3.212
10/9/1997	1.460	26.309	11.531	23.513	0.000	0.000	3.328	1.297	5.569	-0.392
10/10/1997	2.110	26.329	9.141	23.863	0.000	0.000	3.329	1.837	4.247	1.275
10/11/1997	0.000	26.285	10.085	23.290	0.000	0.000	3.277	1.019	6.992	-0.299
10/12/1997	-5.250	26.290	12.564	24.465	0.000	0.000	3.212	0.000	6.063	4.224
10/13/1997	0.000	26.067	8.852	23.156	0.000	0.000	3.255	0.000	6.353	0.187
10/14/1997	-4.040	28.646	7.428	22.390	0.000	0.000	3.284	0.000	6.745	6.835
10/15/1997	0.000	26.153	9.300	23.503	0.000	0.000	3.307	1.173	6.443	-0.687
10/16/1997	0.000	26.143	10.127	23.540	0.000	0.000	3.324	0.463	4.012	-2.378
10/17/1997	4.690	25.659	9.134	24.044	0.000	0.000	3.406	25.800	5.871	-20.260
10/18/1997	15.440	25.989	9.393	25.326	0.000	0.000	3.360	0.124	3.373	14.666
10/19/1997	4.140	26.175	20.954	26.667	0.000	0.000	3.225	0.000	4.941	-1.932
10/20/1997	-0.550	26.013	8.152	25.823	0.000	0.000	3.250	0.000	6.118	2.128
10/21/1997	-6.710	26.199	8.106	24.702	0.000	0.000	3.309	0.000	6.891	4.625
10/22/1997	0.000	25.585	10.078	23.004	0.000	0.000	3.362	0.000	5.569	-0.374
10/23/1997	-8.180	26.072	9.811	23.865	0.000	0.000	3.370	0.000	5.871	7.886
10/24/1997	-5.800	26.013	7.614	23.936	0.000	0.000	3.432	0.000	5.177	6.132
10/25/1997	0.550	25.894	8.429	23.613	0.000	0.000	3.468	0.000	4.537	0.662
10/26/1997	1.460	26.028	10.800	25.574	0.000	0.000	3.489	0.000	4.785	2.618
10/27/1997	0.000	26.172	8.791	23.305	0.000	0.000	3.461	0.000	4.863	-1.465
10/28/1997	0.910	26.209	4.419	22.395	0.000	0.000	3.398	0.000	5.816	0.486
10/29/1997	0.000	26.102	7.927	20.787	0.000	0.000	3.416	0.000	4.392	-4.339
10/30/1997	0.000	26.023	7.634	21.174	0.000	0.000	3.412	0.000	3.910	-4.351
10/31/1997	-5.250	26.057	7.042	20.790	0.000	0.000	3.384	1.405	2.588	-12.718
11/1/1997	9.940	26.109	8.808	20.618	0.000	0.000	3.295	0.046	3.451	4.559
11/2/1997	6.150	26.131	11.008	22.561	0.000	0.000	3.276	9.526	2.588	-7.634
11/3/1997	1.460	26.143	9.398	23.251	0.000	0.000	3.392	0.046	4.102	-0.768
11/4/1997	1.460	26.111	8.622	23.383	0.000	0.000	3.494	0.587	3.843	1.505
11/5/1997	4.690	26.143	11.651	24.159	0.000	0.000	3.496	2.470	2.588	0.672
11/6/1997	0.000	26.067	8.583	24.357	0.000	0.000	3.537	0.077	5.714	0.390
11/7/1997	0.000	26.026	6.320	23.041	0.000	0.000	3.562	0.355	5.032	-1.871
11/8/1997	-4.690	25.982	8.030	22.131	0.000	0.000	3.409	0.000	5.447	6.503
11/9/1997	0.000	26.104	8.549	24.761	0.000	0.000	3.300	0.000	5.200	0.557
11/10/1997	-1.460	26.121	6.322	22.728	0.000	0.000	3.322	0.046	4.157	-4.064
11/11/1997	-5.250	26.121	7.922	22.759	0.000	0.000	3.252	0.000	4.459	-7.405
11/12/1997	1.210	26.209	8.850	22.471	0.000	0.000	3.351	0.077	3.608	-2.348
11/13/1997	-1.210	26.131	7.308	21.286	0.000	0.000	3.464	0.355	1.557	-8.317
11/14/1997	15.540	25.820	8.003	23.178	0.000	0.000	3.692	16.752	1.961	-5.586
11/15/1997	10.200	24.983	7.964	24.841	0.000	0.000	3.642	0.201	6.063	12.278
11/16/1997	0.000	26.261	9.611	24.668	0.000	0.000	3.472	0.046	3.765	-1.346
11/17/1997	9.390	26.256	7.230	24.320	0.000	0.000	3.503	0.232	4.796	10.264
11/18/1997	4.040	26.182	6.736	23.726	0.000	0.000	3.626	0.000	4.785	-5.337

Date	Change In Storage (ha-m)	Inflow Pump G-250 (ha-m)	Seepage Pump G-250_S (ha-m)	Outflow Pump G-251 (ha-m)	Culvert G-258 (ha-m)	Culvert G-259 (ha-m)	Seepage L-7a (ha-m)	Rain (ha-m)	ET (ha-m)	Remainders (ha-m)
11/19/1997	0.000	26.143	8.862	23.400	0.000	0.000	3.642	0.000	2.981	-3.404
11/20/1997	0.000	26.133	8.754	23.200	0.000	0.000	3.694	0.000	4.012	-2.615
11/21/1997	13.430	26.097	7.538	25.260	0.000	0.000	3.758	11.812	1.726	-1.251
11/22/1997	24.980	20.555	9.723	28.382	0.000	0.000	3.750	49.809	2.341	-18.411
11/23/1997	34.920	22.348	7.805	33.713	0.000	0.000	4.026	0.556	1.177	42.880
11/24/1997	-19.480	26.057	5.613	31.910	0.000	0.000	4.153	0.046	3.463	-14.363
11/25/1997	-15.440	22.290	7.952	29.368	0.000	0.000	4.140	0.046	4.000	-8.548
11/26/1997	-16.890	14.492	4.627	27.477	0.000	0.000	4.063	0.000	3.608	-4.360
11/27/1997	-9.090	25.553	7.240	26.774	0.000	0.000	3.951	0.077	5.032	-6.866
11/28/1997	-9.290	25.850	7.859	23.579	0.000	0.000	3.913	0.046	4.157	-11.363
11/29/1997	3.490	22.688	5.909	24.186	0.000	0.000	3.866	2.625	1.804	0.301
11/30/1997	11.950	26.229	7.719	27.078	0.000	0.000	3.979	33.844	1.659	-23.366
12/1/1997	25.630	26.004	8.886	29.798	0.000	0.000	4.469	0.154	4.169	28.969
12/2/1997	-11.840	10.900	5.843	25.962	0.000	0.000	4.799	0.000	4.494	2.917
12/3/1997	-10.300	23.767	4.416	24.291	0.000	0.000	4.575	0.124	4.157	-10.317
12/4/1997	17.640	49.783	7.776	26.045	0.000	0.000	4.795	28.394	0.392	-38.895
12/5/1997	27.200	36.045	6.305	41.063	0.000	0.000	5.164	0.355	4.012	30.711
12/6/1997	-10.110	64.686	6.068	47.503	0.000	0.000	4.900	0.000	5.581	-26.612
12/7/1997	4.870	58.687	7.957	49.942	0.000	0.000	4.779	0.000	5.200	-3.454
12/8/1997	-5.140	55.927	6.357	47.975	0.000	0.000	4.697	0.000	4.404	-13.385
12/9/1997	-15.990	34.031	6.366	44.792	0.000	0.000	4.825	0.000	3.988	-6.066
12/10/1997	-11.940	32.578	9.104	39.691	0.000	0.000	4.809	0.309	3.306	-6.639
12/11/1997	7.440	67.860	6.765	40.713	0.000	0.000	4.727	0.232	3.059	-21.607
12/12/1997	10.000	37.726	5.011	43.388	0.000	0.000	4.712	0.124	3.451	14.278
12/13/1997	-2.650	30.097	8.921	44.511	0.000	0.000	4.859	45.332	0.941	-37.486
12/14/1997	65.260	12.716	12.809	60.196	0.000	0.000	6.028	89.969	0.941	17.684
12/15/1997	5.440	30.038	9.814	52.144	0.000	0.000	7.055	0.865	3.004	22.630
12/16/1997	-38.770	3.198	7.563	43.495	0.000	0.000	7.209	0.046	3.934	-1.795
12/17/1997	-50.430	0.000	8.458	38.247	0.000	0.000	6.882	0.000	4.549	-14.516
12/18/1997	-35.450	14.073	6.457	32.015	0.000	0.000	6.307	3.536	3.373	-23.978
12/19/1997	16.330	63.644	5.505	30.224	0.000	0.000	5.744	0.000	4.483	-18.351
12/20/1997	2.630	51.807	7.710	34.724	0.000	0.000	5.393	0.000	3.463	-16.383
12/21/1997	12.940	51.141	5.843	35.720	0.000	0.000	4.819	0.000	2.431	-4.869
12/22/1997	-3.690	49.864	5.495	35.859	0.000	0.000	4.330	0.154	3.843	-18.336
12/23/1997	18.640	65.834	5.906	39.280	0.000	0.000	3.830	0.046	3.216	-8.574
12/24/1997	-10.580	37.466	6.472	39.710	0.000	0.000	3.817	0.000	2.196	-9.957
12/25/1997	13.040	60.649	6.934	38.621	0.000	0.000	3.648	0.000	3.216	-9.420
12/26/1997	14.120	56.451	4.429	38.139	0.000	0.000	3.442	0.710	2.353	-5.991
12/27/1997	9.490	26.236	8.417	40.569	0.000	0.000	3.857	25.877	2.431	-3.480
12/28/1997	-6.790	33.138	7.768	38.842	0.000	0.000	3.952	0.000	4.181	-0.857
12/29/1997	-12.860	25.820	6.900	37.540	0.000	0.000	3.788	0.232	2.588	-2.571
12/30/1997	-9.740	44.241	5.689	33.319	0.000	0.000	3.700	0.124	4.965	-19.521
12/31/1997	7.600	44.315	8.272	35.519	0.000	0.000	3.614	0.000	5.188	0.378
1/1/1998	-14.140	12.642	8.385	33.305	0.000	0.000	3.417	0.000	3.463	6.569
1/2/1998	-23.700	8.241	6.667	31.761	0.000	0.000	3.384	0.000	3.820	0.256
1/3/1998	-29.190	0.000	6.936	27.320	0.000	0.000	3.329	0.000	2.577	-2.622
1/4/1998	-35.450	0.000	6.303	25.972	0.000	0.000	3.293	0.000	5.726	-7.045

Date	Change In Storage (ha-m)	Inflow Pump G-250 (ha-m)	Seepage Pump G-250 S (ha-m)	Outflow Pump G-251 (ha-m)	Culvert G-258 (ha-m)	Culvert G-259 (ha-m)	Seepage L-7/a (ha-m)	Rain (ha-m)	ET (ha-m)	Remainders (ha-m)
1/5/1998	-14.960	0.000	7.029	20.619	0.000	0.000	3.210	0.000	3.384	-5.233
1/6/1998	-14.500	40.349	8.214	21.198	0.000	0.000	3.214	4.508	2.600	38.773
1/7/1998	38.550	59.947	5.119	21.450	0.000	0.000	3.308	1.915	2.981	-12.181
1/8/1998	52.340	55.200	8.287	25.093	0.000	0.000	3.380	24.828	4.236	1.739
1/9/1998	23.900	36.701	7.462	32.103	0.000	0.000	3.323	0.386	4.392	19.985
1/10/1998	8.700	51.095	6.332	33.478	0.000	0.000	3.152	0.000	5.267	-6.802
1/11/1998	-0.750	23.941	7.756	34.354	0.000	0.000	3.091	0.000	5.816	12.388
1/12/1998	-20.750	2.483	8.933	30.364	0.000	0.000	3.043	0.000	5.436	9.524
1/13/1998	41.420	0.000	4.030	27.141	0.000	0.000	3.008	0.000	3.216	-14.071
1/14/1998	-21.110	0.000	4.930	23.625	0.000	0.000	2.918	0.000	5.020	4.617
1/15/1998	-16.700	23.621	7.355	23.002	0.000	0.000	2.933	9.526	2.341	-27.437
1/16/1998	31.040	38.636	5.923	26.601	0.000	0.000	3.062	10.190	4.326	10.078
1/17/1998	1.290	17.303	4.991	24.394	0.000	0.000	2.953	0.000	5.369	8.217
1/18/1998	-18.100	15.639	7.511	23.750	0.000	0.000	2.843	0.000	3.910	-8.922
1/19/1998	16.890	4.937	7.773	21.326	0.000	0.000	2.799	0.000	2.431	0.869
1/20/1998	24.250	0.000	4.678	19.515	0.000	0.000	2.668	0.000	3.608	3.795
1/21/1998	-7.160	12.733	7.223	19.525	0.000	0.000	2.634	2.162	2.196	-2.967
1/22/1998	-1.290	40.011	3.080	17.068	0.000	0.000	3.201	3.057	3.373	-27.118
1/23/1998	6.990	0.683	6.300	18.617	0.000	0.000	3.559	0.000	1.412	22.777
1/24/1998	-18.200	0.000	3.098	17.340	0.000	0.000	3.284	0.942	2.745	2.341
1/25/1998	13.590	34.469	5.405	17.078	0.000	0.000	2.974	0.000	2.365	-31.590
1/26/1998	24.430	51.875	4.678	17.034	0.000	0.000	3.023	6.346	1.702	18.078
1/27/1998	36.550	60.649	7.514	20.435	0.000	0.000	3.097	7.334	2.286	-11.809
1/28/1998	29.460	26.965	7.345	26.505	0.000	0.000	2.883	0.077	5.683	31.722
1/29/1998	-29.580	0.000	5.128	23.596	0.000	0.000	2.830	0.000	4.157	4.657
1/30/1998	-20.560	0.000	7.727	21.445	0.000	0.000	2.699	0.000	4.694	2.880
1/31/1998	23.140	0.000	6.949	19.750	0.000	0.000	2.591	0.000	4.761	-1.220
2/1/1998	23.700	0.000	4.739	15.654	0.000	0.000	2.556	0.000	5.647	-4.955
2/2/1998	4.870	40.716	7.555	17.707	0.000	0.000	2.875	51.724	1.479	-80.999
2/3/1998	46.890	0.000	6.188	21.482	0.000	0.000	3.890	1.961	1.267	63.788
2/4/1998	-7.500	35.423	5.304	11.409	0.000	0.000	3.753	1.065	4.953	31.379
2/5/1998	60.220	49.013	6.261	3.868	0.000	0.000	3.284	0.000	5.188	16.979
2/6/1998	14.320	16.408	3.137	14.678	0.000	0.000	3.224	18.204	1.949	6.889
2/7/1998	8.830	36.877	5.747	22.140	0.000	0.000	3.152	0.124	3.945	-5.237
2/8/1998	25.380	29.187	4.685	20.795	0.000	0.000	2.911	0.000	4.024	18.101
2/9/1998	-15.180	34.100	7.318	22.794	0.000	0.000	2.812	0.000	4.573	24.725
2/10/1998	44.780	19.379	7.321	23.095	0.000	0.000	2.660	0.000	5.279	8.885
2/11/1998	42.380	78.579	3.389	28.235	0.000	0.000	2.632	0.046	3.204	7.438
2/12/1998	17.630	19.828	6.726	32.375	0.000	0.000	2.465	0.046	2.824	30.489
2/13/1998	-17.550	42.071	4.578	35.252	0.000	0.000	2.411	0.046	3.373	23.454
2/14/1998	-16.290	0.526	6.078	32.490	0.000	0.000	2.303	0.000	5.032	18.403
2/15/1998	23.980	49.937	7.445	32.304	0.000	0.000	2.424	54.550	1.008	97.579
2/16/1998	93.590	35.262	7.198	39.935	0.000	0.000	3.401	8.152	2.196	88.906
2/17/1998	38.500	0.000	7.203	50.238	0.000	0.000	4.076	49.763	1.557	40.544
2/18/1998	-29.580	0.000	7.624	47.831	0.000	0.000	4.812	0.077	5.871	19.233
2/19/1998	-53.580	0.000	6.229	39.262	0.000	0.000	5.190	0.000	4.494	15.014
2/20/1998	-33.650	0.000	3.878	30.630	0.000	0.000	5.122	0.463	3.530	5.076



Date	Change In Storage	Inflow Pump G-250	Seepage Pump G-250 S	Outflow Pump G-251	Culvert G-258	Culvert G-259	Seepage L-7a	Rain	ET	Remainders
	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)
2/21/1998	-31.530	0.000	6.550	28.788	0.000	0.000	4.730	0.046	6.365	-1.153
2/22/1998	-46.020	1.774	3.582	24.247	0.000	0.000	4.773	0.000	4.157	-24.163
2/23/1998	-1.270	0.230	6.007	23.870	0.000	0.000	4.754	29.969	5.424	-6.929
2/24/1998	23.070	92.307	2.985	21.702	0.000	0.000	4.173	0.046	6.836	-44.919
2/25/1998	58.180	80.864	3.956	23.640	0.000	0.000	3.709	0.000	6.455	3.702
2/26/1998	19.190	29.510	5.464	29.231	0.000	0.000	3.438	0.046	5.188	20.615
2/27/1998	-25.110	18.331	3.724	29.679	0.000	0.000	3.283	0.046	4.628	-12.464
2/28/1998	-1.180	36.407	4.536	27.437	0.000	0.000	2.968	14.158	4.236	-23.041
3/1/1998	28.020	24.533	4.556	31.741	0.000	0.000	3.246	29.367	1.557	4.172
3/2/1998	26.110	50.838	4.255	34.102	0.000	0.000	3.446	6.948	5.985	4.965
3/3/1998	-25.560	26.038	3.230	32.120	0.000	0.000	3.441	0.000	5.032	-17.887
3/4/1998	-4.690	18.062	5.632	29.923	0.000	0.000	3.085	0.000	6.455	10.541
3/5/1998	-47.420	0.000	3.088	28.294	0.000	0.000	2.932	0.000	6.208	-15.850
3/6/1998	-37.690	0.000	5.645	24.531	0.000	0.000	2.837	0.000	5.177	-10.819
3/7/1998	-28.300	0.000	6.836	21.061	0.000	0.000	2.587	0.000	5.436	-4.390
3/8/1998	-30.880	0.000	7.186	17.643	0.000	0.000	2.408	0.000	4.381	-11.264
3/9/1998	19.780	0.000	10.785	23.332	0.000	0.000	2.887	45.409	4.259	-0.925
3/10/1998	-14.630	0.443	16.581	18.341	0.000	0.000	3.180	0.000	5.616	5.704
3/11/1998	-25.380	5.505	7.460	19.513	0.000	0.000	2.688	0.000	6.534	-7.526
3/12/1998	-22.700	0.000	9.713	16.936	0.000	0.000	2.273	0.000	6.389	-1.648
3/13/1998	-14.690	24.386	8.174	15.527	0.000	0.000	1.901	0.278	6.051	-19.677
3/14/1998	26.400	53.184	6.207	15.583	0.000	0.000	1.551	0.046	4.169	-8.629
3/15/1998	27.850	44.344	4.734	15.710	0.000	0.000	1.316	0.000	3.608	1.508
3/16/1998	12.380	26.603	3.619	15.992	0.000	0.000	1.109	0.046	5.424	6.037
3/17/1998	-10.390	9.709	11.130	39.588	0.000	0.000	0.975	0.046	5.020	23.488
3/18/1998	-6.610	49.937	5.292	17.105	0.000	0.000	0.890	4.786	2.039	-43.079
3/19/1998	83.930	47.486	9.006	19.527	0.000	0.000	1.293	60.664	2.600	-3.386
3/20/1998	52.360	0.000	11.502	33.283	0.000	0.000	2.339	33.335	4.561	54.530
3/21/1998	-41.730	0.000	5.045	27.457	0.000	0.000	2.988	0.000	4.953	-12.308
3/22/1998	-27.390	0.000	6.562	24.411	0.000	0.000	2.758	0.000	3.396	-2.341
3/23/1998	-6.690	73.683	4.747	21.834	0.000	0.000	2.191	0.046	6.130	-54.647
3/24/1998	74.290	108.742	4.162	25.960	0.000	0.000	1.676	0.000	6.310	-3.858
3/25/1998	45.200	51.119	7.228	32.294	0.000	0.000	1.384	0.000	5.823	30.819
3/26/1998	-22.090	26.581	3.995	37.043	0.000	0.000	1.098	0.000	5.906	-6.820
3/27/1998	-27.390	11.989	4.541	34.124	0.000	0.000	0.895	0.000	4.404	-1.746
3/28/1998	-42.280	0.000	7.834	29.583	0.000	0.000	0.901	3.999	4.079	-13.518
3/29/1998	-31.530	0.000	5.591	26.004	0.000	0.000	0.838	0.077	6.075	-0.366
3/30/1998	-32.340	0.000	7.086	21.646	0.000	0.000	0.750	0.046	5.043	-6.447
3/31/1998	-26.840	0.000	10.085	18.830	0.000	0.000	0.684	0.201	5.110	-3.785
4/1/1998	-27.850	0.000	6.839	16.523	0.000	0.000	0.596	0.046	5.200	-6.769
4/2/1998	-25.530	0.000	7.210	16.422	0.000	0.000	0.493	0.154	5.424	-4.332
4/3/1998	-20.490	0.000	7.712	11.747	0.000	0.000	0.361	0.000	6.208	-2.896
4/4/1998	-2.910	54.510	4.020	10.868	0.000	0.000	0.208	0.046	5.906	-40.900
4/5/1998	68.590	71.006	7.257	9.704	0.000	0.000	0.070	0.000	8.259	15.477
4/6/1998	18.530	41.685	4.842	16.956	0.000	0.000	0.020	0.000	7.710	1.491
4/7/1998	13.780	50.613	6.638	16.875	0.000	0.000	0.057	0.000	5.828	-14.187
4/8/1998	41.270	51.051	4.703	16.929	0.000	0.000	0.129	0.000	5.581	12.600

Date	Change In Storage (ha m)	Inflow Pump G 250 (ha m)	Seepage Pump G 250_S (ha m)	Outflow Pump G 251 (ha m)	Culvert G 258 (ha m)	Culvert G 259 (ha m)	Seepage L 7a (ha m)	Rain (ha m)	ET (ha m)	Remainders (ha m)
4/9/1998	11.770	43.769	6.998	18.441	0.000	0.000	0.159	0.463	5.267	8.913
4/10/1998	25.070	44.770	5.092	23.449	0.000	0.000	0.166	0.000	7.957	11.540
4/11/1998	-8.660	27.484	4.798	23.515	0.000	0.000	0.218	0.000	6.232	6.615
4/12/1998	-1.840	59.557	7.311	25.575	0.000	0.000	0.277	0.000	6.600	29.495
4/13/1998	24.280	38.871	5.072	21.452	0.000	0.000	0.316	0.000	6.220	15.765
4/14/1998	16.290	25.392	5.955	25.164	0.000	0.000	0.354	0.000	6.220	-10.652
4/15/1998	4.890	36.221	7.529	23.393	0.000	0.000	0.336	0.046	5.973	2.347
4/16/1998	24.100	8.771	3.898	22.520	0.000	0.000	0.364	0.154	7.385	3.485
4/17/1998	-31.530	0.000	7.497	21.852	0.000	0.000	0.373	1.652	8.012	-3.691
4/18/1998	-3.100	53.847	5.439	18.492	0.000	0.000	0.326	0.000	7.228	31.553
4/19/1998	46.540	79.146	5.647	19.902	0.000	0.000	0.271	0.000	8.338	-4.637
4/20/1998	29.390	30.733	7.546	23.895	0.000	0.000	0.184	0.000	5.804	28.172
4/21/1998	-6.450	48.176	7.137	27.364	0.000	0.000	0.159	26.356	3.608	50.169
4/22/1998	72.920	112.292	6.031	31.337	0.000	0.000	0.317	0.046	9.279	0.881
4/23/1998	77.860	128.753	7.820	40.185	0.000	0.000	0.219	0.000	8.495	-2.432
4/24/1998	65.350	129.238	6.391	62.523	0.000	0.000	0.183	0.000	8.808	7.260
4/25/1998	39.720	106.662	8.280	69.905	0.000	0.000	0.223	0.000	7.138	9.878
4/26/1998	3.840	105.578	9.094	76.653	0.000	0.000	0.250	0.000	7.216	-18.119
4/27/1998	34.820	111.081	6.944	76.098	0.000	0.000	0.224	0.000	7.385	6.998
4/28/1998	10.850	103.254	6.900	84.796	0.000	0.000	0.206	0.000	5.714	-2.100
4/29/1998	5.870	78.246	10.621	85.341	0.000	0.000	0.229	30.000	4.000	-13.264
4/30/1998	63.030	87.260	11.343	87.140	0.000	0.000	0.349	98.430	6.443	29.426
5/1/1998	51.140	13.902	12.867	87.631	0.000	0.000	0.724	0.587	5.973	129.531
5/2/1998	88.140	0.000	12.314	85.738	0.000	0.000	1.021	0.154	9.008	5.431
5/3/1998	117.790	0.000	6.530	76.888	0.000	0.000	1.119	0.000	10.306	-31.715
5/4/1998	64.670	61.821	9.432	56.130	0.000	0.000	1.048	27.807	9.334	89.883
5/5/1998	43.130	58.386	6.985	55.264	0.000	0.000	1.036	0.232	8.561	47.302
5/6/1998	-54.720	22.999	5.664	52.445	0.000	0.000	0.942	5.419	8.616	-23.019
5/7/1998	5.360	98.089	3.937	46.081	0.000	0.000	0.759	0.201	7.698	39.909
5/8/1998	63.460	135.293	5.931	46.563	0.000	0.000	0.597	0.000	9.189	16.678
5/9/1998	62.120	128.748	5.358	61.650	0.000	0.000	0.446	0.000	8.561	3.137
5/10/1998	44.310	127.706	6.330	72.782	0.000	0.000	0.378	0.000	9.593	-1.399
5/11/1998	21.040	121.555	8.123	80.942	0.000	0.000	0.259	0.000	11.083	8.749
5/12/1998	30.200	103.151	8.541	85.936	0.000	0.000	0.181	0.000	9.726	22.530
5/13/1998	0.000	103.244	9.124	93.203	0.000	0.000	0.122	0.000	9.871	-0.292
5/14/1998	24.900	127.185	35.590	89.777	0.000	0.000	0.099	0.000	9.122	-53.285
5/15/1998	-4.140	128.616	9.195	85.929	0.000	0.000	0.134	0.000	10.799	36.662
5/16/1998	-1.460	128.330	8.089	85.437	0.000	0.000	0.139	0.046	10.389	-34.150
5/17/1998	5.250	128.658	8.999	84.179	0.000	0.000	0.144	0.000	9.816	-29.557
5/18/1998	2.110	126.943	11.221	83.416	0.000	0.000	0.141	0.000	9.098	-32.460
5/19/1998	-11.850	102.923	8.627	82.966	0.000	0.000	0.133	0.046	7.844	-24.143
5/20/1998	20.430	79.873	3.856	77.507	0.000	0.000	0.135	0.000	8.549	-14.382
5/21/1998	-34.100	51.704	10.545	71.263	0.000	0.000	0.137	0.046	9.883	-4.841
5/22/1998	-19.450	51.750	11.213	62.548	0.000	0.000	0.118	0.000	10.353	1.553
5/23/1998	-26.290	51.755	7.905	55.543	0.000	0.000	0.099	0.000	10.263	-12.338
5/24/1998	-5.250	51.777	10.898	53.855	0.000	0.000	0.078	0.000	8.314	5.064
5/25/1998	0.850	75.471	9.390	50.857	0.000	0.000	0.067	0.000	8.012	-15.819

Date	Change In Storage (ha-m)	Inflow Pump G-250 (ha-m)	Seepage Pump G-250_S (ha-m)	Outflow Pump G-251 (ha-m)	Culvert G-258 (ha-m)	Culvert G-259 (ha-m)	Seepage L-7a (ha-m)	Rain (ha-m)	ET (ha-m)	Remainders (ha-m)
5/26/1998	11.400	70.240	8.590	50.862	0.000	0.000	0.049	0.000	6.130	-1.897
5/27/1998	8.990	82.305	9.633	51.677	0.000	0.000	0.033	0.000	6.981	-14.690
5/28/1998	18.300	122.252	10.374	56.661	0.000	0.000	0.036	7.612	2.667	-52.272
5/29/1998	44.040	122.003	11.054	63.477	0.000	0.000	0.080	3.690	4.236	-14.021
5/30/1998	7.410	24.912	10.239	69.445	0.000	0.000	0.093	32.872	6.812	25.790
5/31/1998	-32.470	0.000	13.154	70.270	0.000	0.000	0.140	1.729	6.498	42.429
6/1/1998	-46.200	69.893	9.635	56.409	0.000	0.000	0.183	0.664	7.518	-53.013
6/2/1998	30.650	103.112	10.399	51.741	0.000	0.000	0.183	0.000	8.538	-12.366
6/3/1998	57.590	93.242	9.373	30.890	0.000	0.000	0.168	0.000	8.695	3.765
6/4/1998	69.280	50.395	11.172	11.367	0.000	0.000	0.131	0.000	9.691	39.812
6/5/1998	-5.920	0.000	9.087	9.278	0.000	0.000	0.112	2.007	10.173	11.412
6/6/1998	-7.360	0.000	10.641	0.000	0.000	0.000	0.084	0.124	10.028	2.460
6/7/1998	-15.990	0.000	9.669	0.000	0.000	0.000	0.069	0.000	10.934	-5.125
6/8/1998	-15.440	0.000	8.943	10.000	0.000	0.000	0.077	0.000	6.926	1.409
6/9/1998	-30.580	0.220	9.160	24.570	0.000	0.000	0.098	0.000	8.549	2.221
6/10/1998	-40.420	0.000	10.161	31.719	0.000	0.000	0.070	0.386	7.832	-1.325
6/11/1998	-13.130	17.333	11.935	28.949	0.000	0.000	0.042	61.096	8.145	-54.507
6/12/1998	21.590	8.982	12.192	32.399	0.000	0.000	0.032	0.124	9.310	54.162
6/13/1998	-12.900	0.000	12.378	0.000	0.000	0.000	0.004	0.046	9.569	-3.381
6/14/1998	-11.400	0.000	12.351	0.000	0.000	0.000	0.000	0.000	9.189	-2.211
6/15/1998	-16.250	0.000	12.035	14.830	0.000	0.000	0.000	0.046	10.510	9.044
6/16/1998	-25.630	0.000	10.274	18.700	0.000	0.000	0.000	0.232	11.036	3.874
6/17/1998	-19.880	0.000	10.602	0.000	0.000	0.000	0.000	0.000	10.161	-9.719
6/18/1998	-35.070	0.000	8.992	31.034	0.000	0.000	0.000	5.142	9.087	-0.091
6/19/1998	-16.750	0.000	10.354	0.000	0.000	0.000	0.000	0.000	9.871	-6.879
6/20/1998	24.430	0.000	10.898	0.000	0.000	0.000	0.000	98.831	8.773	-65.628
6/21/1998	77.750	0.000	14.952	0.000	0.000	0.000	0.000	3.459	9.412	83.704
6/22/1998	-36.700	0.000	14.700	61.508	0.000	0.000	0.000	0.046	7.553	32.315
6/23/1998	-107.700	0.350	11.355	52.245	0.000	0.000	0.000	0.000	8.471	-47.334
6/24/1998	-29.030	33.875	13.976	43.436	0.000	0.000	0.000	20.829	6.902	-33.395
6/25/1998	6.800	22.493	15.992	37.809	0.000	0.000	0.000	0.201	8.875	30.790
6/26/1998	-33.380	0.000	13.489	36.715	0.000	0.000	0.000	1.729	5.412	7.018
6/27/1998	-43.740	0.000	13.944	31.384	0.000	0.000	0.000	0.201	10.499	-2.058
6/28/1998	-37.130	0.000	12.894	28.255	0.000	0.000	0.000	0.000	9.008	0.133
6/29/1998	-32.440	0.000	11.191	24.257	0.000	0.000	0.000	1.729	7.047	-2.865
6/30/1998	3.800	83.487	12.197	46.974	0.000	0.000	0.000	0.000	10.040	-22.673
7/1/1998	51.580	78.471	12.522	20.239	0.000	0.000	0.000	0.046	9.400	2.702
7/2/1998	40.510	78.040	10.856	26.197	0.000	0.000	0.000	0.077	9.804	-1.606
7/3/1998	48.790	77.715	12.165	31.771	0.000	0.000	0.000	0.232	9.714	12.329
7/4/1998	25.990	77.964	13.249	34.770	0.000	0.000	0.000	0.000	8.236	-8.968
7/5/1998	36.480	78.226	11.541	40.376	0.000	0.000	0.000	0.000	7.216	5.846
7/6/1998	14.340	77.610	12.305	44.971	0.000	0.000	0.000	0.000	9.110	-9.189
7/7/1998	14.340	77.881	13.007	49.220	0.000	0.000	0.000	35.296	6.510	-43.107
7/8/1998	19.480	67.989	14.274	51.865	0.000	0.000	0.000	0.386	8.326	11.296
7/9/1998	-44.230	0.000	13.919	49.707	0.000	0.000	0.025	0.077	9.859	15.234
7/10/1998	-54.580	0.000	12.713	41.423	0.000	0.000	0.045	0.000	7.620	-5.582
7/11/1998	-47.880	0.000	12.928	36.324	0.000	0.000	0.062	0.587	7.228	-4.977

Date	Change In Storage	Inflow Pump G-250	Seepage Pump G-250 S	Outflow Pump G-251	Culvert G-258	Culvert G-259	Seepage L-7a	Rain	ET	Remainders
	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)	(ha-m)
7/12/1998	43.190	0.000	13.085	30.312	0.000	0.000	0.066	1.220	7.318	6.846
7/13/1998	32.890	0.000	12.505	26.880	0.000	0.000	0.076	0.077	8.471	2.308
7/14/1998	-28.400	0.000	10.800	24.078	0.000	0.000	0.136	13.217	-4.326	-13.349
7/15/1998	-14.890	21.981	11.541	23.197	0.000	0.000	0.150	5.574	4.079	15.319
7/16/1998	25.750	52.205	14.362	22.515	0.000	0.000	0.191	38.322	8.169	-34.284
7/17/1998	46.490	26.368	14.688	26.116	0.000	0.000	0.205	0.046	7.440	53.426
7/18/1998	26.060	52.262	15.774	28.003	0.000	0.000	0.194	1.961	7.687	7.333
7/19/1998	19.460	52.073	14.176	33.346	0.000	0.000	0.206	0.232	4.628	4.923
7/20/1998	40.940	15.336	14.406	45.981	0.000	0.000	0.230	85.028	4.863	-8.810
7/21/1998	31.820	66.051	15.816	49.842	0.000	0.000	0.309	39.171	5.647	18.222
7/22/1998	73.670	60.324	15.759	57.627	0.000	0.000	0.643	22.002	7.765	56.093
7/23/1998	30.870	0.000	15.918	52.034	0.000	0.000	0.882	0.000	8.797	29.079
7/24/1998	-44.740	10.670	15.842	45.161	0.000	0.000	0.769	0.000	9.098	-1.920
7/25/1998	-37.110	0.000	15.933	36.043	0.000	0.000	0.671	0.000	9.491	7.753
7/26/1998	-40.980	27.895	15.500	34.185	0.000	0.000	0.652	0.000	7.138	-28.204
7/27/1998	10.090	8.030	14.387	32.385	0.000	0.000	0.656	0.000	9.098	22.707
7/28/1998	-34.640	0.000	12.848	27.897	0.000	0.000	0.624	0.046	9.491	2.077
7/29/1998	-33.090	0.147	12.429	27.046	0.000	0.000	0.604	0.000	9.244	2.449
7/30/1998	34.450	0.000	11.845	20.357	0.000	0.000	0.588	0.000	9.738	-4.943
7/31/1998	21.690	0.000	11.546	19.402	0.000	0.000	0.582	5.682	6.443	2.108
8/1/1998	-21.690	0.000	10.959	17.477	0.000	0.000	0.586	2.702	7.530	0.029
8/2/1998	-11.950	0.000	11.196	16.545	0.000	0.000	0.603	7.288	6.443	3.148
8/3/1998	7.460	0.000	13.193	6.065	0.000	0.000	0.605	4.508	9.985	3.677
8/4/1998	5.100	0.000	13.858	17.181	0.000	0.000	0.625	0.154	9.200	30.702
8/5/1998	11.000	0.000	13.021	15.453	0.000	0.000	0.665	24.704	9.973	11.057
8/6/1998	12.050	0.000	15.150	20.021	0.000	0.000	0.787	15.409	3.239	19.114
8/7/1998	1.110	74.884	15.136	20.156	0.000	0.000	1.019	9.094	6.185	-57.567
8/8/1998	107.370	113.202	15.691	20.085	0.000	0.000	1.019	6.006	6.812	14.040
8/9/1998	61.070	94.218	13.090	29.427	0.000	0.000	0.956	0.355	7.204	2.172
8/10/1998	51.920	106.606	14.460	32.226	0.000	0.000	0.898	0.201	7.173	-16.386
8/11/1998	24.530	88.566	12.897	42.247	0.000	0.000	0.872	0.077	9.816	-13.022
8/12/1998	6.340	25.737	12.877	43.136	0.000	0.000	0.852	16.197	8.785	2.795
8/13/1998	-36.760	0.000	19.155	40.973	0.000	0.000	0.834	0.154	8.549	11.774
8/14/1998	40.350	0.000	10.173	32.539	0.000	0.000	0.821	0.000	10.299	1.667
8/15/1998	-46.320	0.000	10.389	29.449	0.000	0.000	0.824	0.000	9.479	8.216
8/16/1998	-32.990	0.000	10.861	24.927	0.000	0.000	0.829	0.000	8.887	-0.005
8/17/1998	41.730	0.000	9.645	22.899	0.000	0.000	0.808	0.000	8.079	-11.560
8/18/1998	-23.050	0.000	10.061	19.880	0.000	0.000	0.797	0.000	8.471	4.504
8/19/1998	-16.090	0.000	10.494	18.588	0.000	0.000	0.824	29.336	8.224	-19.438